

CLAIMS

1 1. (currently amended) A method, comprising:
2 receiving one or more demands for service in a mesh network comprising a plurality of
3 nodes interconnected by a plurality of links;
4 specifying a threshold corresponding to a maximum number of failure-related cross-
5 connections at a node in the network; and
6 mapping each of the one or more demands onto a primary path and a restoration path in the
7 network to generate a path plan for the one or more demands in the network, wherein:
8 reduction of a portion of restoration time associated with failure-related
9 cross-connections in the network is taken into account during the mapping; and
10 the mapping generates the path plan based on the specified threshold such that, for
11 all nodes in the mesh network, the number of failure-related cross-connections at each node is ~~less~~
12 no more than the specified threshold.

1 2. (canceled)

1 3. (previously presented) The method of claim 1, wherein the mapping results in a
2 maximum number of failure-related cross-connections at all nodes in the network being within a
3 specified tolerance of a theoretical minimum.

1 4. (previously presented) The method of claim 3, wherein a graph-theoretic condition
2 is used to derive the theoretical minimum.

1 5. (previously presented) The method of claim 4, wherein the theoretical minimum is
2 defined by $\max_{n \in N} \{\lceil \delta_n / d_n \rceil\}$ where n , a node in the network, is an element of N , the set of all
3 nodes in the network, δ_n is the number of unit demands terminated on node n , and d_n is the
4 number of edges incident on node n .

1 6. (previously presented) The method of claim 1, wherein the mapping sequentially
2 evaluates each possible path plan for each of the one or more demands and selects the path plan
3 having a smallest maximum number of failure-related cross-connections.

1 7. (previously presented) The method of claim 1, wherein the mapping comprises:
2 selecting two node-disjoint paths for each demand, wherein leveling of link loads is taken
3 into account during the selecting; and
4 for each demand, identifying one of the two node-disjoint paths as the primary path and the
5 other as the restoration path, wherein a maximum number of failure-related cross-connections at all
6 nodes in the network is taken into account during the identifying.

1 8. (previously presented) The method of claim 7, wherein:
2 selecting the two node-disjoint paths for each demand minimizes maximum link bandwidth
3 in the network; and
4 identifying the primary and restoration paths for each demand results in the maximum
5 number of failure-related cross-connections at all nodes in the network being within a specified
6 tolerance of a theoretical minimum.

1 9. (previously presented) The method of claim 8, wherein a tent pole condition is used
2 to derive the theoretical minimum.

1 10. (previously presented) The method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using
4 mixed-integer programming.

1 11. (previously presented) The method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using
4 genetic programming.

1 12. (previously presented) The method of claim 7, wherein the selecting of the two
2 node-disjoint paths for each demand and the identifying, for each demand, of the one of the two
3 node-disjoint paths as the primary path and the other as the restoration path are implemented using
4 a commercial solver.

1 13. (previously presented) The method of claim 1, wherein the mapping involves
2 demand bundling, wherein demands having a common source node and a common destination node
3 are grouped and routed along a single pair of disjoint primary and restoration paths and at least a
4 portion of connection signaling for the group is carried out jointly.

1 14. (previously presented) The method of claim 1, wherein the mapping involves traffic
2 aggregation, wherein multiple low-rate channels in the network are consolidated into a high-rate
3 channel and rerouting of the high-rate channel requires fewer cross-connections than rerouting of
4 the multiple low-rate channels.

1 15. (currently amended) A network manager for a mesh network comprising a plurality
2 of nodes interconnected by a plurality of links, the network manager comprising:
3 means for receiving one or more demands for service in the network;
4 means for specifying a threshold corresponding to a maximum number of failure-related
5 cross-connections at a node in the network; and
6 means for mapping each of the one or more demands onto a primary path and a restoration
7 path in the network to generate a path plan for the one or more demands in the network, wherein:
8 reduction of a portion of restoration time associated with failure-related
9 cross-connections in the network is taken into account during the mapping; and
10 the means for mapping generates the path plan based on the specified threshold such
11 that, for all nodes in the mesh network, the number of failure-related cross-connections at each node
12 is ~~less~~ no more than the specified threshold.

1 16. (canceled)

1 17. (previously presented) The network manager of claim 15, wherein the path plan
2 results in a maximum number of failure-related cross-connections at all nodes in the network being
3 within a specified tolerance of a theoretical minimum.

1 18. (previously presented) The network manager of claim 17, wherein a graph-theoretic
2 condition is used to derive the theoretical minimum.

1 19. (previously presented) The network manager of claim 18, wherein the theoretical
2 minimum is defined by: $\max_{n \in N} \left\{ \left\lceil \delta_n / d_n \right\rceil \right\}$ where n , a node in the network, is an element of N ,
3 the set of all nodes in the network, δ_n is the number of unit demands terminated on node n , and d_n
4 is the number of edges incident on node n .

1 20. (previously presented) The network manager of claim 15, wherein the network
2 manager comprises means for sequentially evaluating each possible path plan for each of the one or
3 more demands and means for selecting the path plan having a smallest maximum number of
4 failure-related cross-connections.

1 21. (previously presented) The network manager of claim 15, wherein the network
2 manager comprises:

3 means for performing selection of two node-disjoint paths for each demand, wherein
4 leveling of link loads is taken into account during the selection; and

5 means for identifying, for each demand, one of the two node-disjoint paths as the primary
6 path and the other as the restoration path, wherein a maximum number of failure-related
7 cross-connections at all nodes in the network is taken into account during the identifying.

1 22. (previously presented) The network manager of claim 21, wherein:
2 the means for performing the selection of the two node-disjoint paths for each demand
3 minimizes maximum link bandwidth in the network; and

4 the means for identifying the primary and restoration paths for each demand results in the
5 maximum number of failure-related cross-connections at all nodes in the network being within a
6 specified tolerance of a theoretical minimum.

1 23. (previously presented) The network manager of claim 22, wherein a tent pole
2 condition is used to derive the theoretical minimum.

1 24. (previously presented) The network manager of claim 21, wherein the means for
2 performing the selection and the means for identifying the primary and restoration paths are
3 implemented using mixed-integer programming.

1 25. (previously presented) The network manager of claim 21, wherein the means for
2 performing the selection and the means for identifying the primary and restoration paths are
3 implemented using genetic programming.

1 26. (previously presented) The network manager of claim 21, wherein the means for
2 performing the selection and the means for identifying the primary and restoration paths are
3 implemented using a commercial solver.

1 27. (previously presented) The network manager of claim 15, wherein the network
2 manager comprises means for considering demand bundling in the generation of the path plan,
3 wherein demands having a common source node and a common destination node are grouped and
4 routed along a single pair of disjoint primary and restoration paths and at least a portion of
5 connection signaling for the group is carried out jointly.

1 28. (previously presented) The network manager of claim 15, wherein the network
2 manager comprises means for considering traffic aggregation in the generation of the path plan,
3 wherein multiple low-rate channels in the network are consolidated into a high-rate channel and
4 rerouting of the high-rate channel requires fewer cross-connections than rerouting of the multiple
5 low-rate channels.

1 29. (previously presented) A method, comprising:
2 receiving one or more demands for service in a mesh network comprising a plurality of
3 nodes interconnected by a plurality of links; and
4 mapping each of the one or more demands onto a primary path and a restoration path in the
5 network to generate a path plan for the one or more demands in the network, wherein:
6 reduction of a portion of restoration time associated with failure-related
7 cross-connections in the network is taken into account during the mapping;
8 the mapping results in a maximum number of failure-related cross-connections at all
9 nodes in the network being within a specified tolerance of a theoretical minimum;
10 a graph-theoretic condition is used to derive the theoretical minimum; and
11 the theoretical minimum is defined by $\max_{n \in N} \left\{ \left\lceil \delta_n / d_n \right\rceil \right\}$ where n , a node in the
12 network, is an element of N , the set of all nodes in the network, δ_n is the number of unit demands
13 terminated on node n , and d_n is the number of edges incident on node n .

1 30. (previously presented) A network manager for a mesh network comprising a
2 plurality of nodes interconnected by a plurality of links, the network manager comprising:
3 means for receiving one or more demands for service in the network; and
4 means for mapping each of the one or more demands onto a primary path and a restoration
5 path in the network to generate a path plan for the one or more demands in the network, wherein:
6 reduction of a portion of restoration time associated with failure-related
7 cross-connections in the network is taken into account during the mapping;
8 the path plan results in a maximum number of failure-related cross-connections at all
9 nodes in the network being within a specified tolerance of a theoretical minimum;
10 a graph-theoretic condition is used to derive the theoretical minimum; and
11 the theoretical minimum is defined by: $\max_{n \in N} \left\{ \left\lceil \delta_n / d_n \right\rceil \right\}$ where n , a node in the
12 network, is an element of N , the set of all nodes in the network, δ_n is the number of unit demands
13 terminated on node n , and d_n is the number of edges incident on node n .